

Probabilistic models for material properties

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Generally, the available information on material properties is limited to some measurements and basic physical properties, so that there may be many models consistent with this information. Consider all models that do not contradict the available information. The collection of these models is referred to as the class of competing models. It is common in applications to (1) use heuristic arguments related to model simplicity and versatility to construct a finite class of competing models, (2) specify the functional form of each competing models, and (3) estimate the parameters of the competing models from measurements. Since the class of competing models used in applications does not include all models consistent with the available information, the output of the model selection problem is a suboptimal model.

The presentation uses the *Structural Mechanics* problem proposed for the *Validation Methodology Workshop* to illustrate various aspects of the construction of the class of competing models and the solution of the model selection problem. We include in the class of competing models elementary models, models that are inconsistent with the physics, and other more realistic models to characterize the modulus of elasticity along a rod. The marginal distribution and the correlation structure of all models are calibrated to available point and global measurements. The resulting material models are used to predict the performance of a specified structure.